IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Declaration Under 37 C.F.R. 1.131

As a below named inventor, I hereby declare that:

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **LARGE MODE AREA FIBERS USING HIGHER ORDER MODES,** and assigned application Serial No. 10/786,738.

I believe that this invention was made prior to July 31, 2001. As evidence of that the following documents are presented:

EXHIBIT A

Eleven pages of illustrations prepared by George Oulundsen for an oral presentation on the effectiveness of twisting LasereWave preforms during draw. The presentation was made at a corporate Quarterly Review held at Bell Labs, Norcross, GA on 6/28/2001. The work on which this presentation is based was done in Sturbridge, MA by George Oulundsen and co-workers. These illustrations describe experiments conducted for commercial practice on commercial prototype apparatus in which preforms for multi-mode (MM) optical fiber was drawn. As described in the illustrations a twist was imparted to the fiber during the draw operation. The term GULP was a term used by the co-workers to describe a technique or techniques for producing twisted optical fiber.

EXHIBIT B

A three page Process/Procedure Change (PPC) document, an internal document of Lucent Technologies Bell Labs, and prepared by Sandeep Pandip, the Draw Development Engineer for the project described and who conducted the GULP experiments in Sturbridge to support the invention. Mr. Pandip was required to submit an ISO controlled document to conduct the GULP experiments. To obtain approval he submitted the PPC form. The PPC form was prepared prior to 5/9/01, the start date indicated on the PPC form. The project referred to ended later than 5/31/01 (the end date on the form) as the inventors continued, periodically, to draw fibers with GULP after the initial data and conception to get a better statistical database and understand if the GULPed fibers showed any adverse effects when compared to standard fibers.

EXHIBIT C

Copy of an e-mail from Sandeep Pandit to co-workers dated May 7, 2001 referring to the PPC of EXHIBIT B.

EXHIBIT D

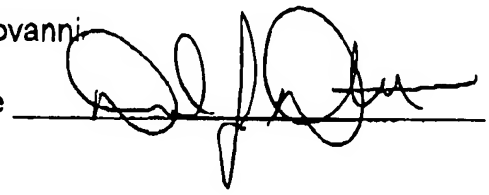
Copy of an e-mail from Sandeep Pandit to co-workers dated May 17, 2001 referring to the work described in EXHIBITS A and B and indicating that he is going to draw more GULPed fiber the week of 5/20/01 based on findings from earlier runs.

EXHIBIT E

Seven pages from the laboratory notebook of Sandeep Pandit dating from May 9, 2001 to July 6, 2001 describing draw experiments and other references to the work described in EXHIBITS A and B.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Inventor David J. DiGiovanni

Inventor's signature  Date 12/6/05

Inventor: Frank DiMarcello

Inventor's signature _____ Date _____

Inventor: XinLi Jiang

Inventor's signature _____ Date _____

EXHIBIT E

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Inventor David J. DiGiovanni

Inventor's signature _____ Date _____

Inventor: Frank DiMarcello

Inventor's signature Frank V. DiMarcello Date 12/6/05

Inventor: XinLi Jiang

Inventor's signature _____ Date _____

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Inventor David J. DiGiovanni

Inventor's signature _____ Date _____

Inventor: Frank DiMarcello

Inventor's signature _____ Date _____

Inventor: XinLi Jiang

Inventor's signature _____ Date 12/7/05

Inventor: George E. Oulundsen III

Inventor's signature George E. Oulundsen III Date 12/6/05

Inventor: Sandeep P. Pandit

Inventor's signature _____ Date _____

Inventor: George E. Oulundsen III

Inventor's signature _____ Date _____

Inventor: Sandeep P. Pandit

Inventor's signature _____ Date 12/12/05

EXHIBIT A

GULPing LaserWave Fiber

George Oulundsen, Xinli Jiang, Sandeep Pandit
OFS - Sturbridge

Leading Optical Innovations

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Overview

- David DiGiovanni, Sean Jones, Steve Golowich and Bill Reed filed a patent application for GULPing non-circular (13% NC) preforms.

Condition	No Vacuum/No Twist	No Vacuum/Twist	Vacuum/No Twist	Vacuum/Twist
FOM	7.0	5.4	4.8	2.7

- OFS-Sturbridge (with DiGiovanni and Dimarcello) investigated GULPing standard circular LaserWave fiber.
  - 850-nm Bandwidth increased 10% and attenuation increased ~4% at 850-nm.
- Sturbridge data consist of 16 preforms (175 fiber spools) .
- Conclusion: GULPing is beneficial to LaserWave yields (+2-3%) and only costs us recipe modifications to our draw towers.

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Three different twist rates were tried.

- Dimarcello twisted at 25-30 twists/meter on standard production LaserWave fiber using wobble wheel and applied only the secondary coating.
- Sturbridge twisted at both 5 twists/meter and 15 twists/meter on standard production LaserWave fiber and standard draw equipment.
- All three twists rates demonstrated higher bandwidth and lower DMD than non-GULPed fiber.
- Unclear as to which twist rate is best. Belief is that the higher twist rate the better.

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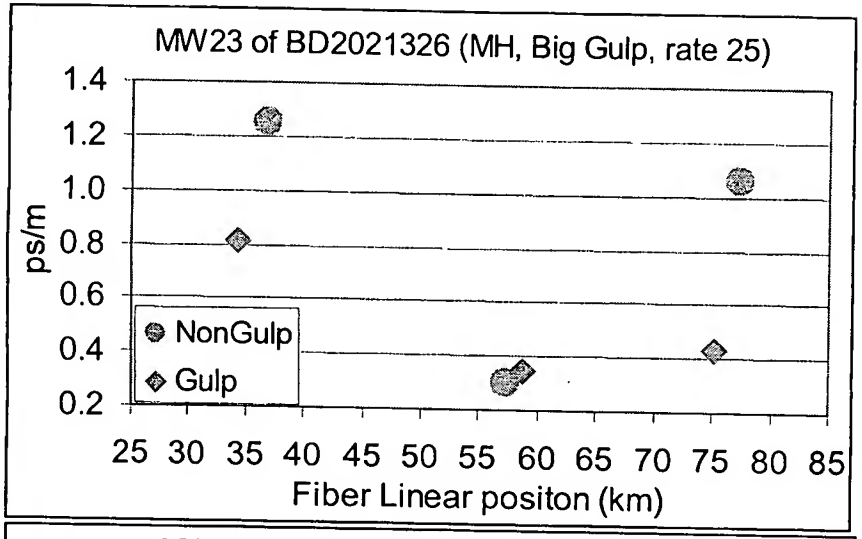
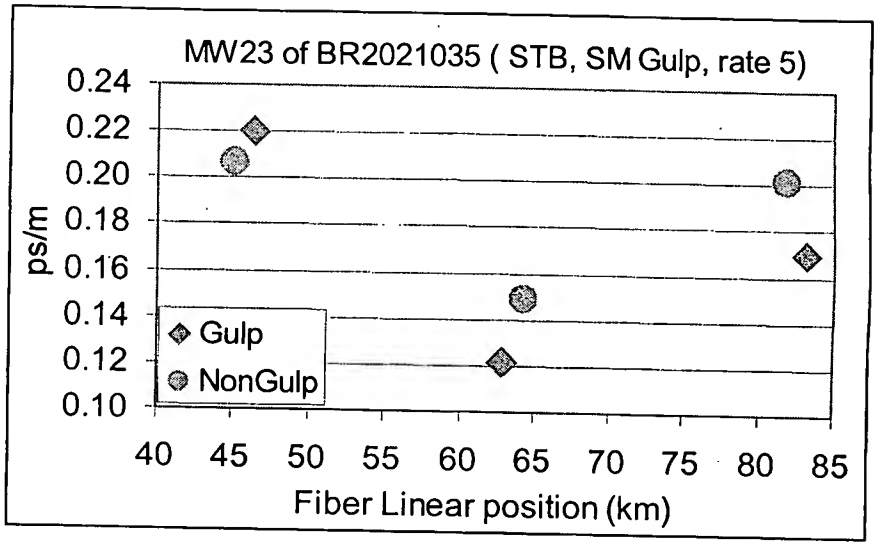
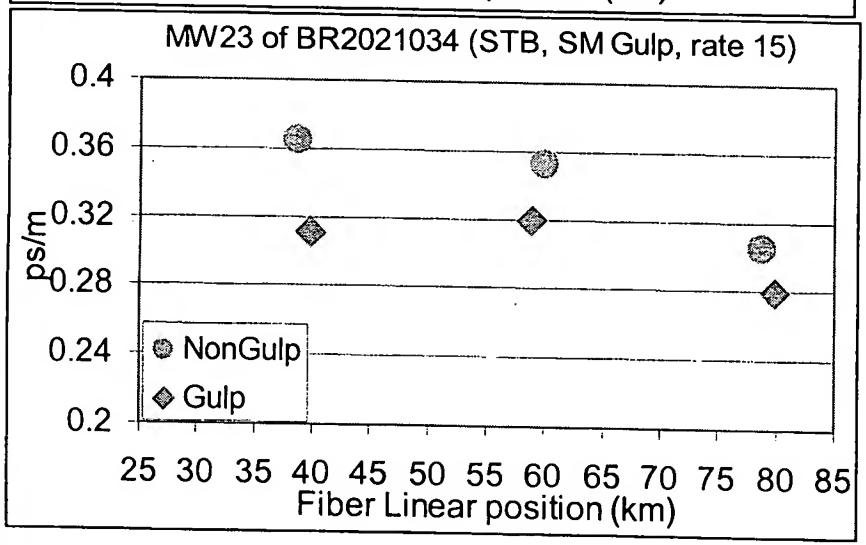
Turning GULP off and on for given preform...







GULPed spools Mask Widths are between 7% and 50% lower than non-GULPed sister spools.

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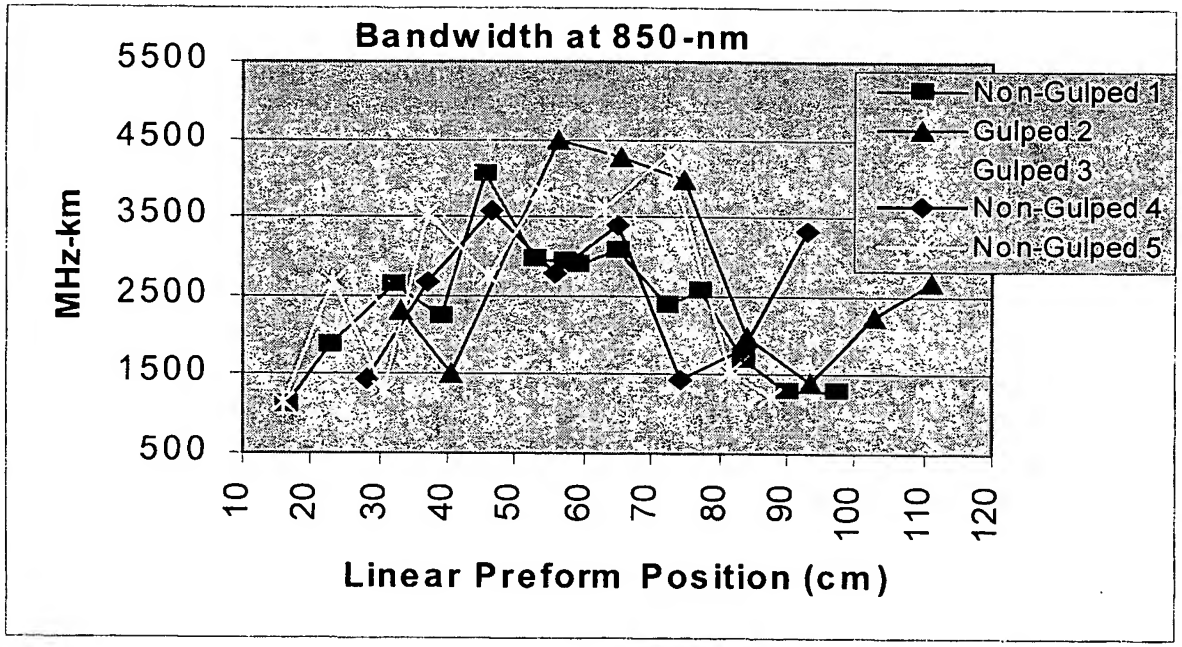
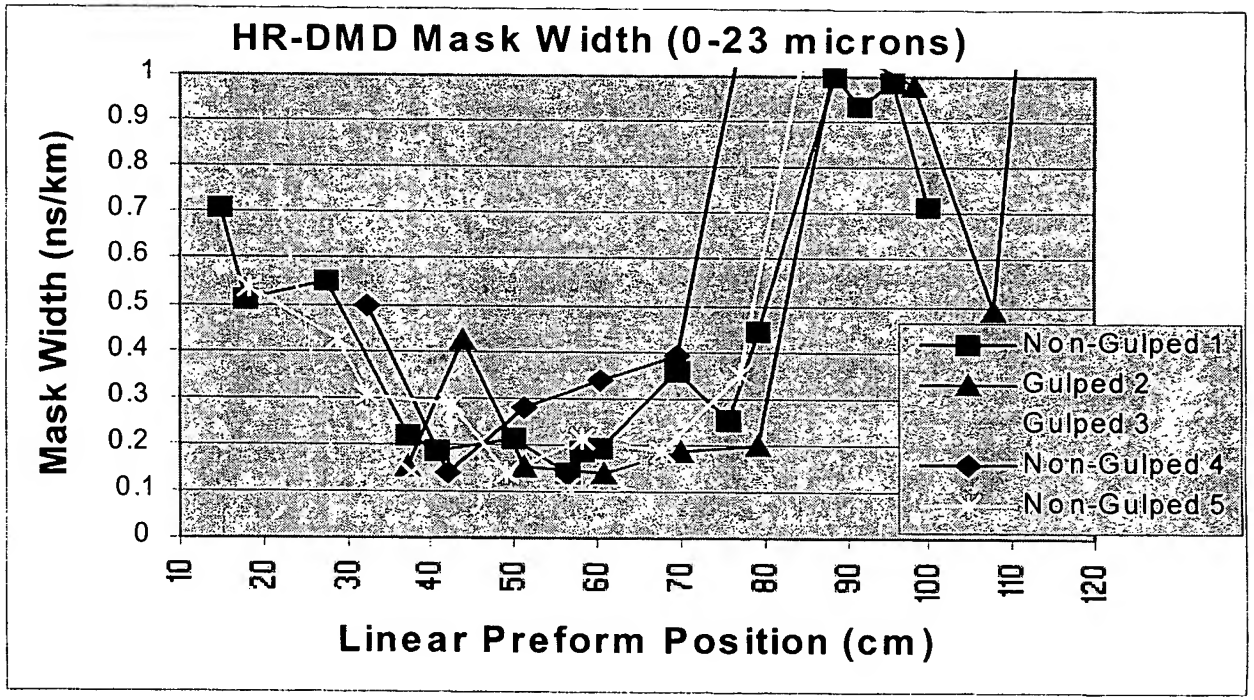


Individual GULPed preforms compared to Individual non-GULPed preforms

GULPed preforms and then ran the next preform non-GULPed. Preforms were from the same lathe using the same recipe and were drawn on the same towers.



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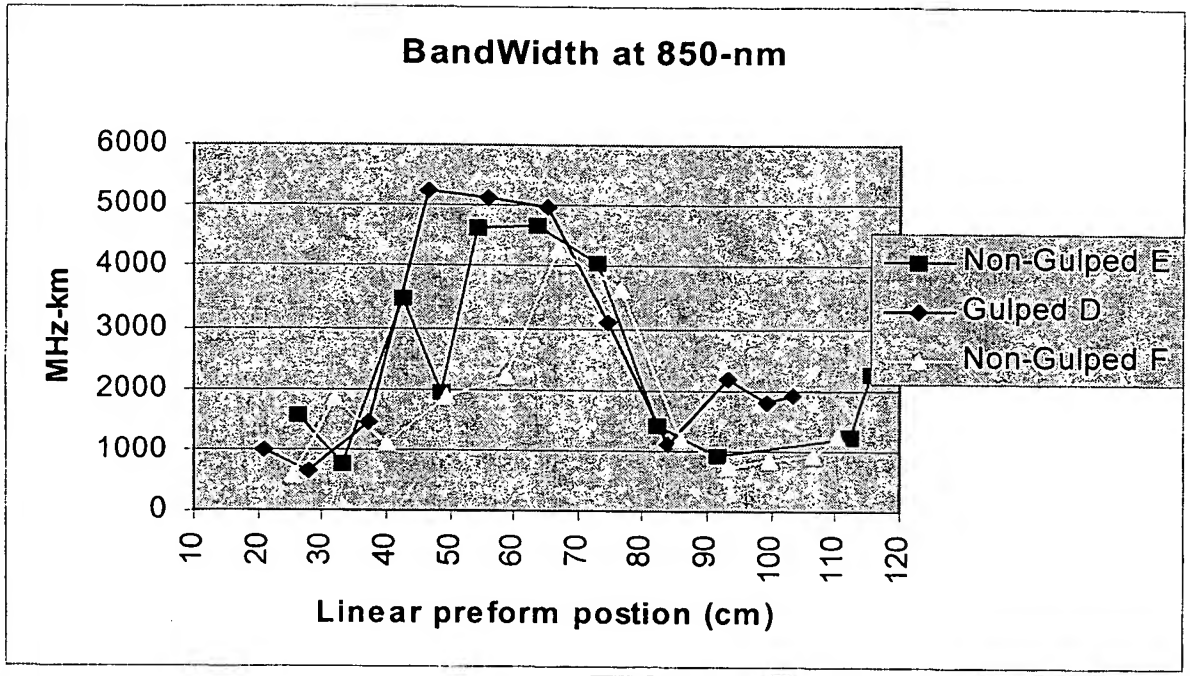
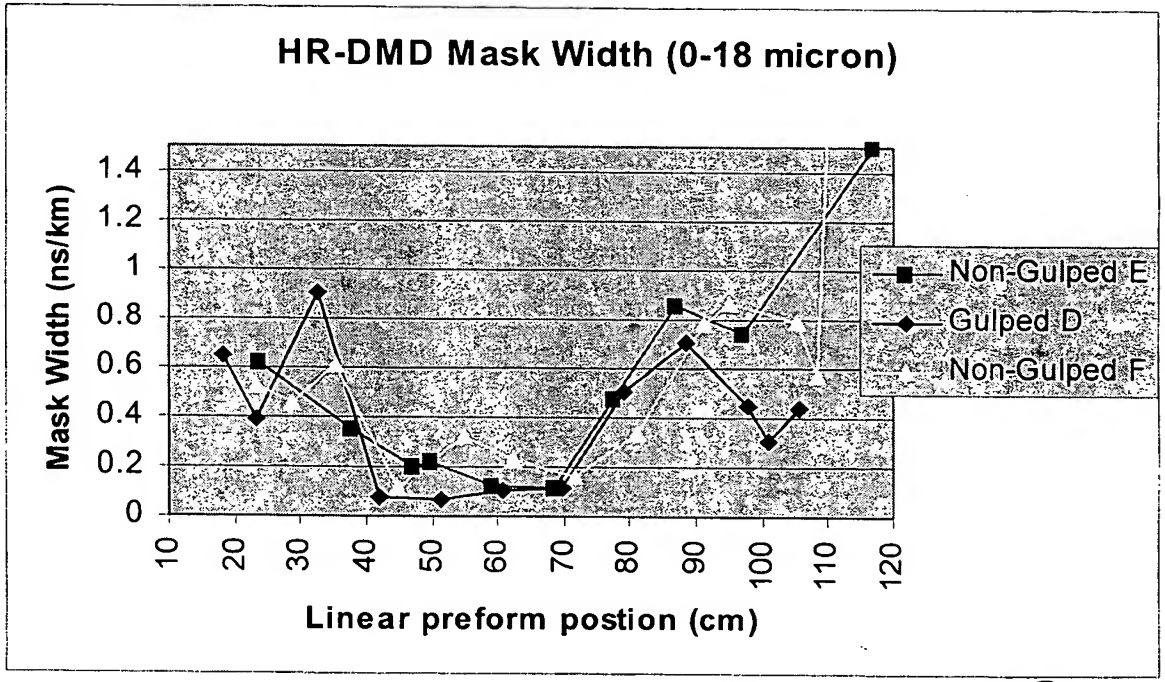


Individual GULPed preforms compared to Individual non-GULPed preforms

GULPed preforms and then ran the next preform non-GULPed. Preforms were from the same lathe using the same recipe and were drawn on the same towers.



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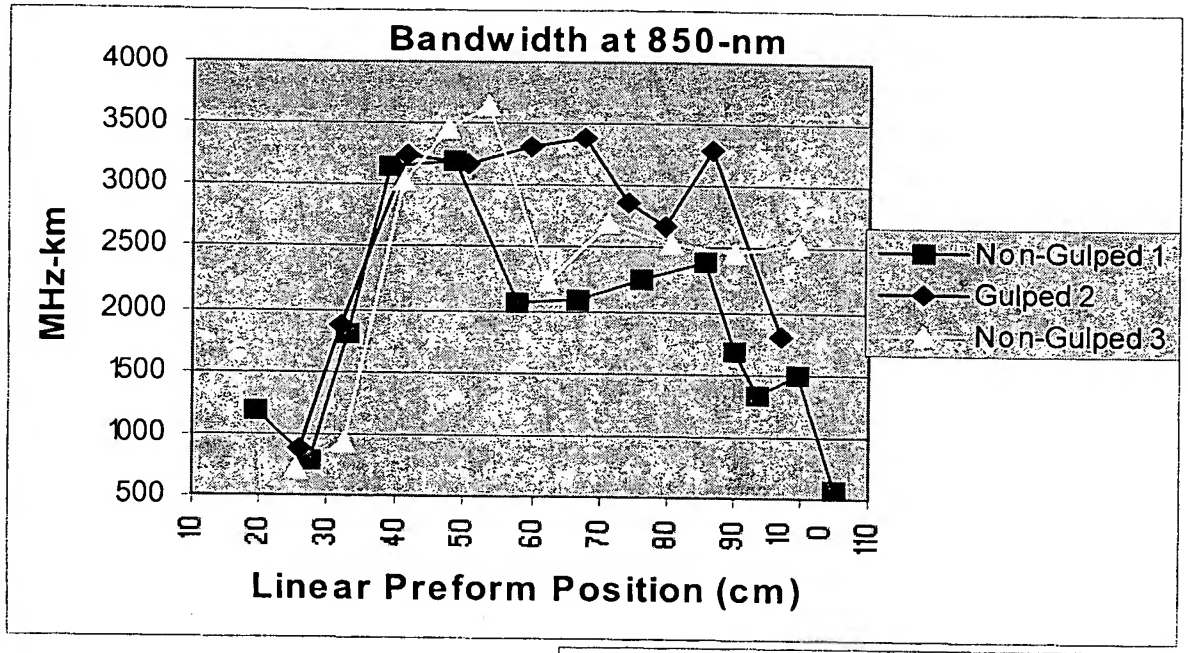
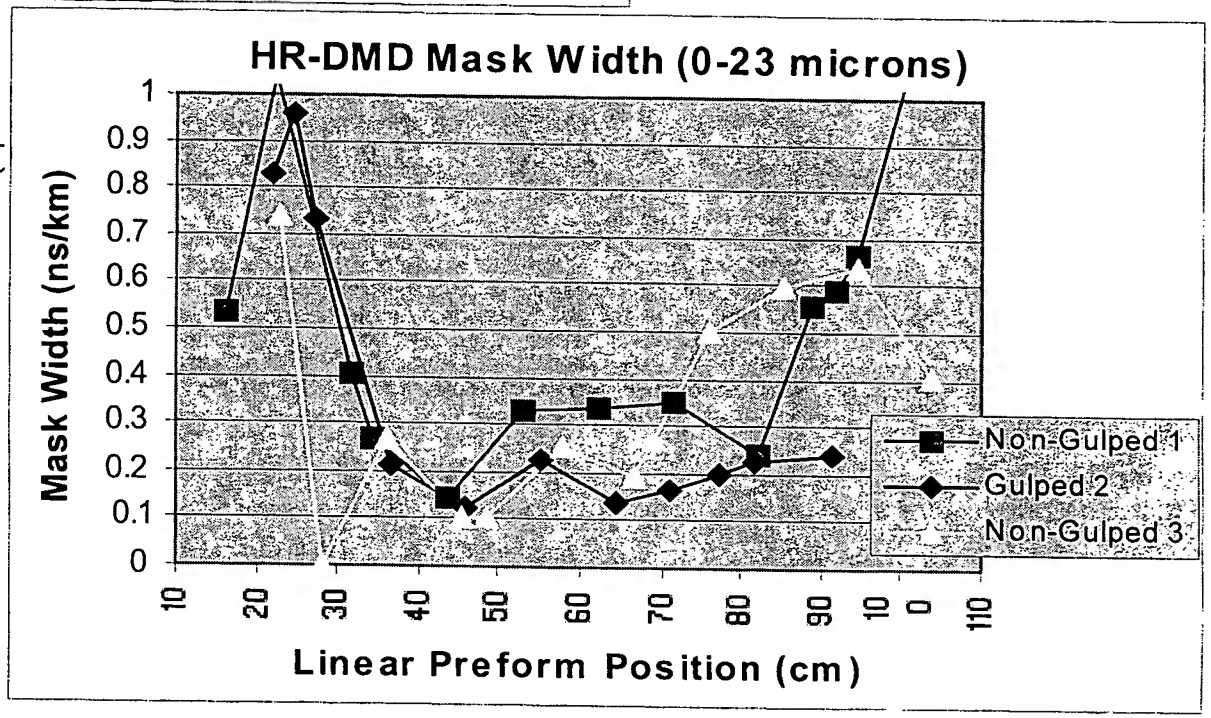


Individual GULPed preforms compared to Individual non-GULPed preforms

GULPed preforms and then ran the next preform non-GULPed. Preforms were from the same lathe using the same recipe and were drawn on the same towers.



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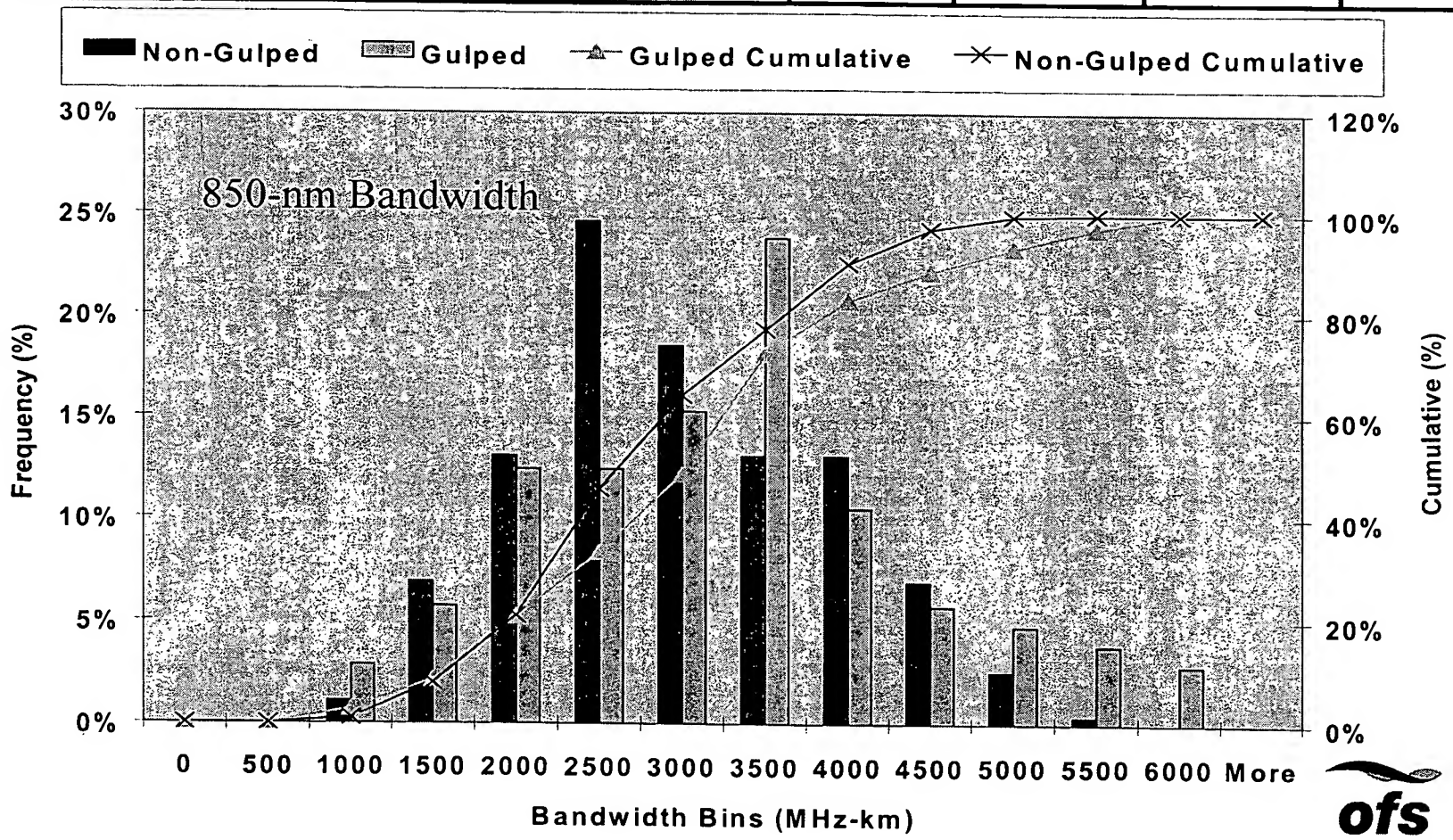
Comparison of 105 GULPed Spools to 276 non-GULPed spools

Average Values from each	Attenuation (dB/km)			Bandwidth (MHz-km)		
data set from same time	1300-nm	1380-nm	850-nm	1300-nm	850-nm	Alpha
Non-Gulped (276 spools)	0.5305	0.8463	2.2029	678	2733	2.0979
Gulped (105 spools)	0.6174	0.9258	2.2966	677	3019	2.0982
Delta (Gulped-nonGulped)	0.0869	0.0795	0.0936	-1	286	0.0003



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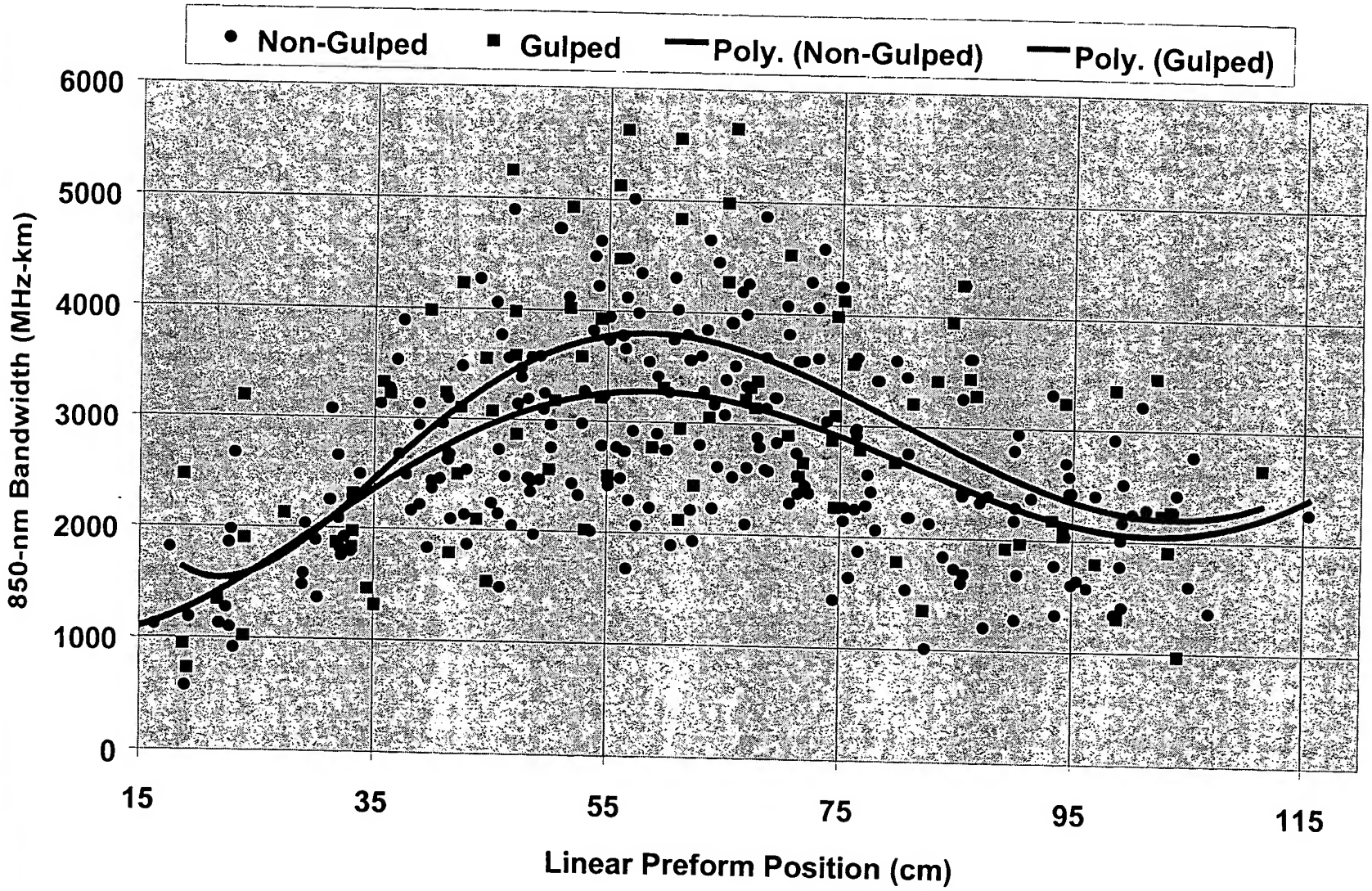
850-nm Bandwidth vs Linear Preform Position: GULPed vs Non-GULPed



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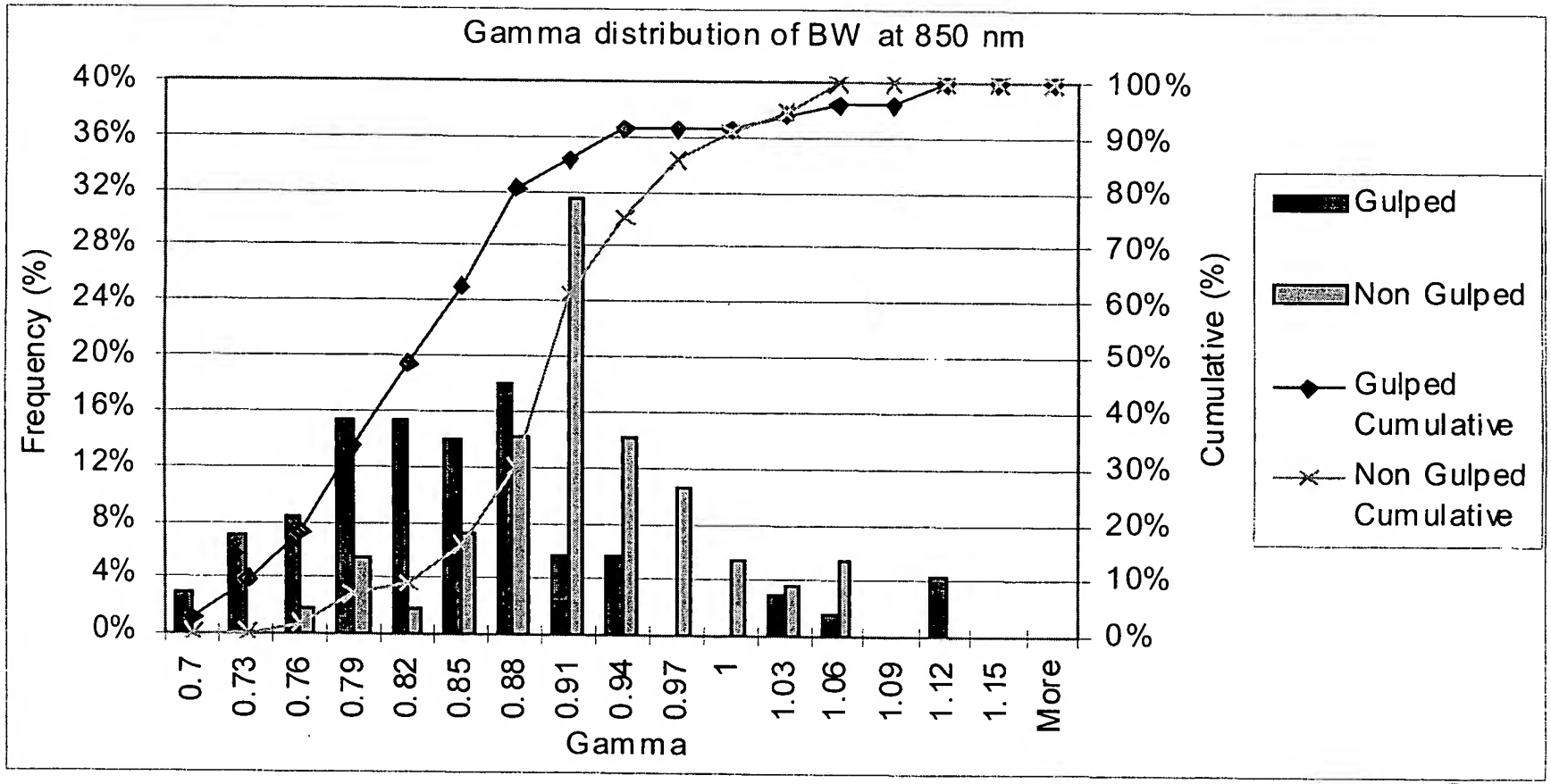
Cutback value (gamma) for GULPed fiber is less than for non-GULPed.

$$\frac{BW_1}{BW_2} = \left(\frac{L_1}{L_2}\right)^{1-\gamma}$$

$\gamma = 1$ means no mode-mixing

$\gamma = 0.5$ means perfect mode-mixing

Implies that there is more mode-mixing in the GULPed fiber.



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Conclusions:

GULPing LaserWave fiber will improve mode-mixing and improve bandwidth.

GULPed LaserWave fiber shows a 10% increase in 850-nm bandwidth and a 4% increase in 850-nm attenuation.

GULPing LaserWave reduces the DMD mask width in production fibers by 2-3%.

Future work includes optimizing twist rate.

Thanks to John Ritger, Man Yan, and David DiGiovanni for many very useful conversations regarding multimode fiber.

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EXHIBIT B

Process / Procedure Change (PPC)

Lucent Technologies
Bell Labs Innovations

Pending	Open	Closed	Conclusions Posted	Revision	Revised	PPC #
		X	10/21/03	G	8/14/01	1_37_B_MODQ

Key: PPC# W_XX_Y_MOPDQR
W=Last digit of year XX=PPC# Y=PPC type M=MCVD O=Overcollapse/Glass Prep P=PIP D=Draw Q=QC R=Other

SECTION A.

Initiator	Start Date	End Date
Sandeep Pandit	5/9/01	~~8/17/01~~9/21/01

One sentence overview of change from / to: Draw 50/125 preforms for Laser Wave on a 8m. singlemode tower using "Gulp".

What is the problem? Laser Wave yields are lower than the targets set for the year. Gulping the 50/125 fiber could reduce the mask width and increase the yields. Gulp experiments at Murray Hill revealed a yield increase to Laser Wave fiber.

What is the objective (short term / long term)? To introduce glass twist in 50/125 fiber using GULP to potentially increase LaserWave yields by decreasing maskwidth compared to non-twisted fiber

What is the physical basis? One LTS 50/125 preform drawn at Murray Hills at 25-30 glass twists per meter has shown a decrease in the mask width. If maskwidth reduction is reproduced at LTS, this will increase yields on both Laser Wave 100 and 300. This PPC will determine if there is a benefit to gulping Laser Waver preforms.

Amount of material to be processed? 2 preforms for initial trials, up to 6 preforms total to be selected and held at 503 to be drawn

Products effected (check all that apply):	SM ☐ MM 50 ☒ MM 62.5 ☐ Not Applicable ☐

Does change effect Equipment Maintenance? No
If so, how?

MESA				
MESA MSG Req'd?	Attach by	Process	Owner Code	WIP messaging req'd at station
yes	process	202E009		0700

SECTION B. CONCLUSIONS
Permanent change recommended? No

How was the experimental / analytical work performed?

What were the data and analysis methods used?

Discussion and conclusions (attach supporting data):
No Data Available. Employee effected in workforce reduction. TH>

SECTION C. MESA MESSAGING LEVEL
0700/17/137BMOPDQ: If using GULP and M coat for 202 product, please attach PPC 1_37_B_MODQ and change process to 202E009

Process / Procedure Change (PPC)

Lucent Technologies
Bell Labs Innovations

Pending	Open	Closed	Conclusions Posted	Revision	Revised	PPC #
		X	10/21/03	G	8/14/01	1_37_B_MODQ

Key: PPC# W_XX_Y_MOPDQR
W=Last digit of year XX=PPC# Y=PPC type M=MCVD O=Overcollapse/Glass Prep P=PIP D=Draw Q=QC R=Other

SECTION D. EXPERIMENTAL PROCEDURE

Initiator	Start Date	End Date
Sandeep Pandit	5/9/01	~~8/17/01~~9/21/01

Department	Equipment Required	Operator Attach PPC Label	Operator Attach Lot in MESA	PPC Type	
MCVD (M)	standard	No	No	B	
OC/GP (O)	standard	No	No	Type A	Type B
PIP (P)	standard	No	No	Procedure Change Max 2 PPCs may be attached in MESA	Process Change Max 1 PPC may be attached in MESA
Draw (D)	Draw preforms on DCSM tower using gulp	No	Yes		
QC (Q)	All standard tests. HR-DMD testing and M Coat at geometry.	No	No		
Other (R)		No	No		

MCVD (M)

Procedure: standard
Preform Size:
Spec. Change:
Wareflow Required: standard (Joe Sledziewski an R&D technician will attatch PPC to selected preforms)

Overcollapse / Glass Prep (O)

Procedure: standard
Spec. Change:
Wareflow Required:

PIP (P)

Procedure: standard
Wareflow Required: standard

Draw (D)

Procedure: Preform will be drawn under Engineering supervision using the Gulp on a DCSM tower with M coat. The furnace will be changed to 202 graphite and powerhead. The draw speed will be 300 mpm. Two preforms are to be drawn with the GULP at specified positions. Two different GULP settings will be used on the two preforms, the usual setting (4 Hz, 4 Degree) and a high twist setting. After the two preforms are drawn, the tower will be reconverted back for DCSM draws. If the above experiment is successful, 12 more preforms will be drawn with the GULP setting that worked.
Spec. Change:
Wareflow Required:

QC (Q)

Procedure: All standard QC tests except M Coat at geometry. Do not scrap any fiber for high attenuation.
Spec. Change:
Wareflow Required: Testing Required: A: Normal Testing(Product might be sampled) B: See prior test
C: See prior test
Special Testing Requirements (State clearly and specifically): Normal wareflow, M Coat at geometry. Do not scrap any fiber for high attenuation

Process / Procedure Change (PPC)

Lucent Technologies
Bell Labs Innovations

Pending	Open	Closed	Conclusions Posted	Revision	Revised	PPC #
		X	10/21/03	G	8/14/01	**1_37_B_MODQ**

Key: PPC# W_XX_Y_MOPDQR
W=Last digit of year XX=PPC# Y=PPC type M=MCVD O=Overcollapse/Glass Prep P=PIP D=Draw Q=QC R=Other

Other (R)

Procedure:
Spec. Change:
Wareflow Required:

SECTION E: MATERIAL DISPOSITION Hold at 1850 Other (specify):

EXHIBIT C

From: "Pandit, Sandeep P (Sandeep)" <IMCEAEX-_O=LUCENT_OU=NJ746001_CN=RECIPIENTS_CN=SPANDIT@ofsoptics.com>
To: "LTS PPC Approval" <LTSPPCA@holmdel.exchange.lucent.com>; "Roach, Robert L (Bob)" <roachr@lucent.com>
Cc: "Oulundsen, George E, III (George)" <goulundsen@lucent.com>; "Jiang, XinLi (XinLi)" <jiangx@lucent.com>; "Sledziewski, Joseph T, JR (Joe)" <jsledziewski@lucent.com>
Sent: Monday, May 07, 2001 9:19 AM
Attach: PPC_LTS Gulp.doc
Subject: 202 GULP PPC

I am attaching a PPC to GULP 202 preforms on 8m DCSM tower to increase LaserWave yields. Please review for approval.

<<PPC_LTS Gulp.doc>>

Sandeep Pandit
Draw Development Engineer
Lucent Technologies - Sturbridge
(508) 347-4134
(508) 347-4114 Fax
spandit@lucent.com

EXHIBIT D

From: "Pandit, Sandeep P (Sandeep)" <IMCEAEX-_O=LUCENT_OU=NJ746001_CN=RECIPIENTS_CN=SPANDIT@ofsoptics.com>
To: "Jiang, XinLi (XinLi)" <jiangx@lucent.com>; "Oulundsen, George E, III (George)" <goulundsen@lucent.com>
Cc: "Mazzarese, David J (Dave)" <dmazzarese@lucent.com>; "Oliviero, Andrew (Andrew)" <aoliviero@lucent.com>
Sent: Thursday, May 17, 2001 1:12 PM
Subject: Gulp LW additional draws

I scheduled two more draws for 202s next week on SM tower. One whole preform with GULP and other with no GULP. We will use the GULP setting that works best based on our current testing.

Sandeep Pandit
Draw Development Engineer
Lucent Technologies - Sturbridge
(508) 347-4134
(508) 347-4114 Fax
spandit@lucent.com

EXHIBIT E

Computation Book

Number of Book 5

Name SANDEEP P. PANDIT

Subject DRAW DEVELOPMENT ENGINEERING

Used Form 03/29/01 To

Item No. 09-9890
11¾ in. x 9⅜ in. • 152 Pages

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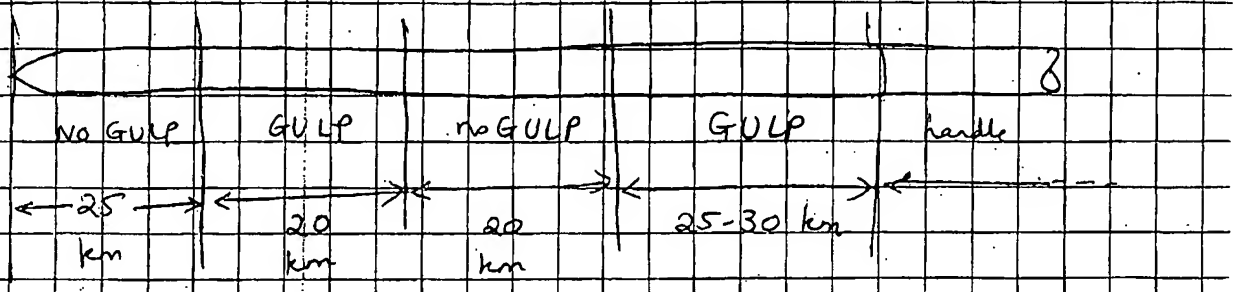
5/9/01 GULP 202 at LTS



1. Change tower to MM graphite in furnace (202)
2. 300 mpm Draw Speed
3. GULP setting = 38 (4Hz, 80) change to 34 (4Hz, 40) @ end of 1st run
4. Rcp = 202 MM300_Exp0.txt
5. Preform = BR-202-1034 BR-202-1035
6. Turn off GULP immediately on starting
7. Preform will attach PPC | -37_B-M0202 Process | 202E008
8. Hold @ 0800 H Chris Josephson once drawn
9. Disable alarm that comes on if no GULP
10. From GULP / no GULP change → induce a defect (Ideal Cut file)
11. SM, 330 dies → w/ 30°C, 30°C, 30°C
12. M coat.
13. ~~Add 2nd~~

25/10/01 : BR-202-1034 (000 91811)

① GULP = 38 (4 Hz, 8°) → gave max. glass taint on DCSM

② Rcp = 202MM300_EXP.txt

③ Die = 9.1, 14.6 mils (330 mpm dies)

④ Draw speed = 300 mpm, M coat

⑤ furnace P = 0.05 Torr, Top MFC down = 8.7 slpm, Top MFC ~~up~~ upward = [illegible]

⑥ (Dual diffuser ring on furnace gas screen assembly)

⑦ He consumption = 36.8 slpm

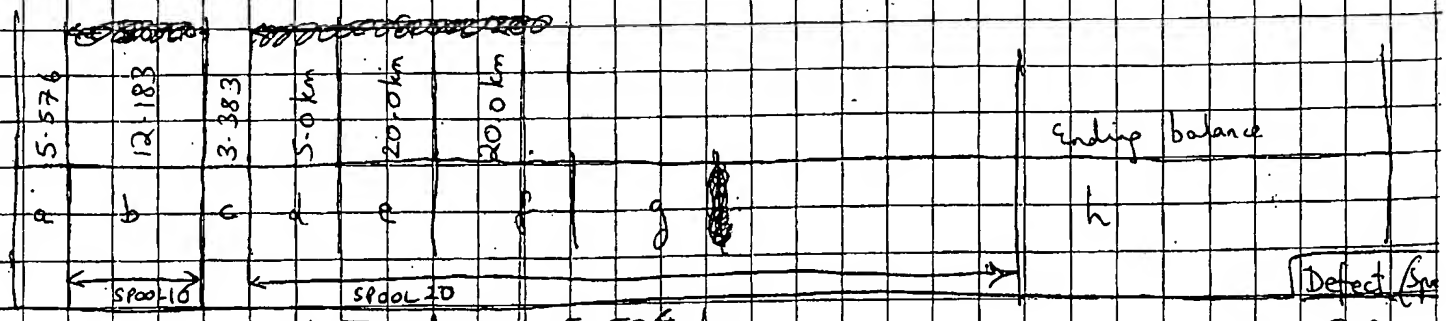
⑧ Startup loss = 5.575 km

⑨ Tension = 65g

⑩ ~~3~~ 3 km on good spool 10 = major clad upset

- Spool 10 : 3.2 km on spool = major clad upset

- Spool 20 : 1st 5.0 km → no GULP (Total ~~km~~ km = (Spool 20 = 25 km)
Next 20.0 km → GULP



Defect (Sp
5.0
25.0
45.0

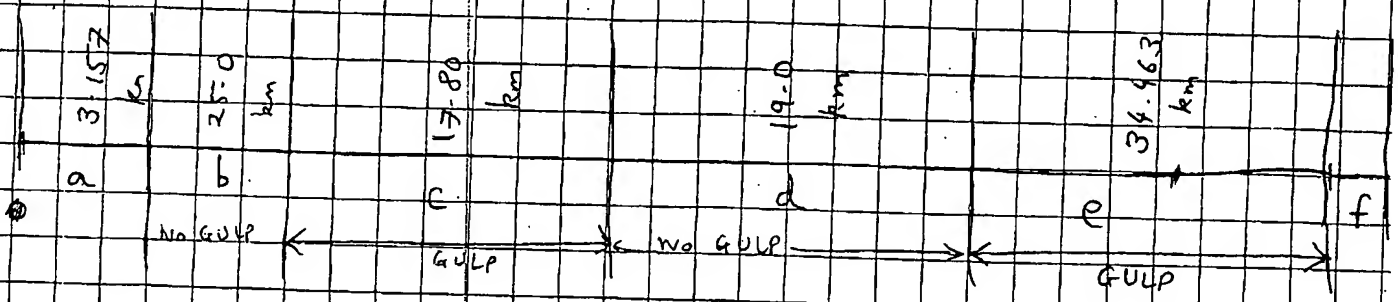
Section a = Startup loss = 5.576 km
b = Spool 10 → No GULP → 12.183 km
c = Restart loss 3.383 km
d = Spool 20 → ~~no~~ no GULP → 5.0 km
e = Spool 20 → GULP (4 Hz, 8°) → 20.0 km
f = Spool 20 → no GULP → 20 km
g = Spool 20 → GULP (4 Hz, 8°) → remaining
~~h~~ h = Ending balance

10/01 BR-202-1035T (0009187-3)

① GULP = 34 (4Hz, 4°) → the usual DCSM setting

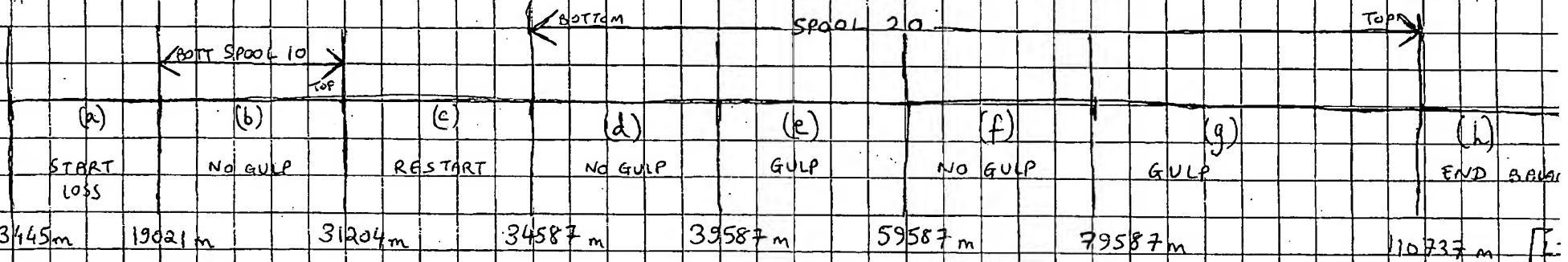
② All other recipe params same as BR-202-034 (Pg 42)

All fiber on one drum spool

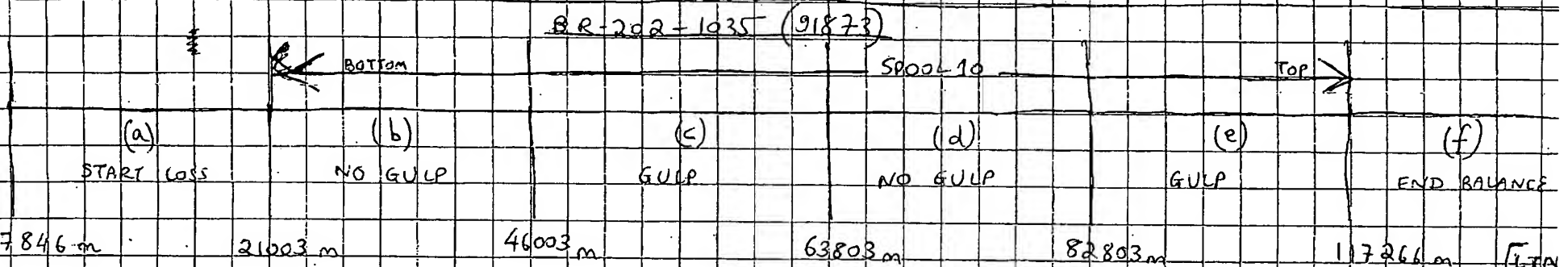


a = Start loss → 3.157 km
b = No GULP → 25 km
c = GULP → 7.8 km
d = No GULP → 19.0 km
e = GULP → 34.463 km
f = Ending Balance

5/14/01 IN TERMS OF : LINEAR POSITIONS BR-202-1034 (91811)



BR-202-1035 (91873)



5/02

MM issues

1. 62.5 μm GULP expt
2. MM 420 mpm process w/ GULP → ie 36" chiller qual + dies/coa
3. Keeping GULP on MM towers
4. T2S → long term plan

Qual Samples

	MESA		length (m)	Location
BR-202-1035-C1	91873BE	GULP (34)	5960	1850
BR-202-1035-BA	91873BC	No GULP	5980	1850
→ BR-202-1034-21	91811AG	GULP (38)	8513	1800
BR-202-1034-24	91811AN	No GULP	8533	1800

Qual tests:

1. Twist
2. μ-bend / Macrobend
3. Temp cycling

All tests passed (for MM GULP)

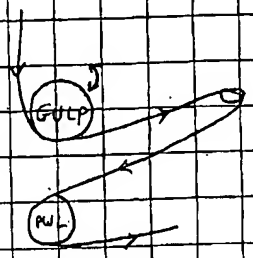
6/7/01 (N) coat, 500 mpm DCM

→ ① BR-202-1036 (9/931)

GULP @ 38 (ie 4 Hz, 8°)

T12

M coat, 300 mpm

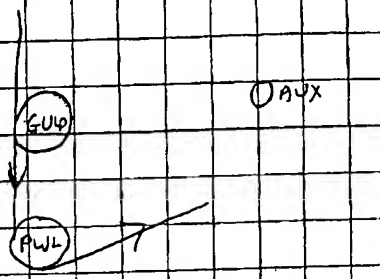


Drawn by error ② BE-202-1540 (93253)

No GULP

300 mpm, M coat, Straight Through

T12 : MM graphite



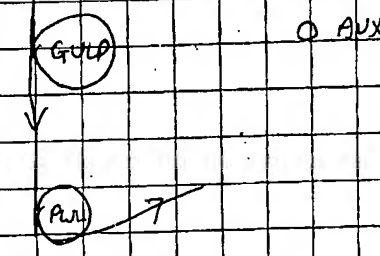
STRAIGHT THROUGH

Drawn by error ③ BB-202-193 (93231)

No GULP

300 mpm, M coat, straight through

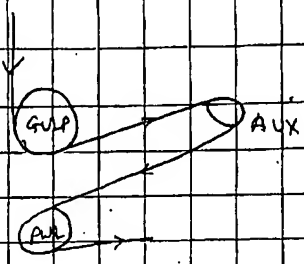
T12



STRAIGHT THROUGH

→ (4) BR-202-1038 (92046)

No GULP
T12 300 mpm, M coat



5/21/01 (1) Ramp-in Spec Temp adjustment
(2) NCTM w/ linespeed ~~adj~~ compensation
(8) Auto Ramp to 420 → if after 3 min → automatically go to 420 mpm

6 7/5/01 : FOU. PREFORMS DRAWN ON TOWER 12 BETWEEN 7/3/01 & 7/6/01 (inclusive)

ALL PREFORMS, GULP SETTING = 38 (4 HZ, 8°), M COAT, 330 DCSM DIES, 300 MPM SPEED, 65 g TORQUE 22° CHILLE

(1) BB-202-1206 (94234)
(2) BB-202-217 (94984)
(3) BD-202-1557 (94819)
(4) BR-202-1037 ~~(95330)~~ (91982)
(5) BD-202-1563 ~~(91989)~~ (95339)
(6) BE-202-1570 (95316)
→ (7) BD-202-1544 (93994)
(8) BP-202-1003 (90867)
(9) BD-202-1429 (85603)
(10) BR-202-1068 (94168)